Rheological hardening of natural rubber and carbon black nanocomposites

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Filled elastomers exhibit exquisite mechanical properties that are exploited in a wide range of applications, and in particular in the tire and car industry. Nanocomposites are obtained by dispersing fillers, for instance carbon black or silica particles, into a polymer matrix. In conventional processes, the polymer and the particles are mixed together at high temperature in an internal mixer until particle scale dispersion is achieved.

Here we address the case of nanocomposites made from natural rubber and carbon black. We implement an alternative cold process that consists in mixing the concentrated suspension of natural rubber latexes, which are directly harvested from the hevea tree, and a slurry of carbon black particles in water. The slurry is injected into the natural rubber suspension at room temperature. A highly elastic spongy material containing water is then irreversibly formed. After water removal and drying, natural rubber/carbon black nanocomposites are obtained.

The mechanical properties of these nanocomposites pose many interesting questions. First they depend on the thermomechanical history that they have experienced. Second their linear and non linear viscoelastic properties continuously increase with the storage time, which is detrimental to further processing. We will describe the relation that exists between the compositional parameters, the presence of residual water, the microstructure, and the rheological hardening and aging properties of these materials.